Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

REMARKS

Claims 1-22 are pending in the present application. Claims 1, 6 and 8 are amended. Claims 12-22 are withdrawn. Reconsideration of this application is respectfully requested.

Amendments to Claims 1, 6 and 8

Claims 1 and 6 have been amended to recite "thereby generating an OPCed masked design."

Claim 8 has been amended to recite non-OPC related errors related to photolithographic processes. No new matter is added.

Election and Restrictions to Claims 1-22

The Examiner requires an election between Group I, Claims 1-11, drawn to mask fidelity inspection methods and systems for making fidelity inspection; Group II, Claims 12-17, drawn to mask fidelity inspection methods and systems for making fidelity inspection; or Group III, Claims 18-22, drawn to mask fidelity inspection methods and systems for making fidelity inspection.

Applicants hereby provisionally elect Group I, Claims 1-11.

Objection to Specification

The replacement Abstract sheet including the amended Abstract responsive to the Examiner's request, is attached hereto. The title of the application has been deleted from the original Abstract and the content of Abstract has been amended, to yield an Abstract including 150 words or less. Withdrawal of the objection to the Specification is respectfully requested.

Claim Rejections under 35 U.S.C. §112, First Paragraph

The Action rejects Claims 1, 6 and 8 under 35 U.S.C. §112, first paragraph, contending that Claims 1, 6 and 8 fail to comply with the enablement requirement. Specifically, the Examiner states that the feature of "predetermined photolithograph processing condition" recited

Page 8 of 17

DM2\867797.3

PAGE 11/21 * RCVD AT 11/30/2006 6:42:22 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-3/17 * DNIS:2738300 * CSID:6197442201 * DURATION (mm-ss):06-16

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

in Claims 1 and 6 is not described in the application specification; and that the feature of "non-OPC related errors" is not defined or listed in the specification. Applicants submit that Claims 1, 6 and 8 satisfy this enablement requirement in view of following arguments.

> M.P.E.P. 2164.01 states that:

> The enablement requirement refers to the requirement of 35 U.S.C. §112, first paragraph that the specification describe how to make and how to use the invention. The invention that <u>one skilled in the art must be enabled to make</u> and use is that defined by the claim(s) of the particular application or patent. (Emphasis added).

Generally, the phrase "photolithography processing condition" refers to conditions for forming a photoresist pattern such as exposure conditions for creating an image from a mask on a photoresist layer. Applicants respectfully submit that the phrase "predetermined photolithography processing conditions" clearly conveys what is disclosed, to <u>one skilled in the art</u>. In Paragraph [0010] of the disclosure, Applicants point out that a mask inspection system replicates an optical exposure tool's critical parameters used during the exposure of the photoresist. In particular, the system matches the parameters such as wavelength, the partial coherence of the exposure light, illumination aperture and the imaging numerical aperture (NA) of the optical exposure system, <u>which are known to one of skill in the art to be photolithography processing conditions</u>. Accordingly, one of ordinary skill in the art and in possession of the specification, would be enabled to make and use the claimed methods of Claims 1 and 6 in view of the phrase "predetermined photolithography processing condition." Therefore the rejection of claims 1 and 6 under 35 U.S.C. §112, first paragraph, should be withdrawn.

Claim 8 has been amended to recite that a comparison tool further includes means for detecting <u>non-OPC related errors related to photolithographic processes</u>. The phrase "non-OPC related errors" generally refers to errors not related to an OPC mask, OPC model or methods of forming an OPC mask. In Paragraph [0029] of the disclosure, Applicants provide that the method separates possible <u>errors caused purely by processes for making the mask</u> from <u>other errors caused by other photolithography processes</u> when using the actual mask; and that by using

DMZ\867797.3

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

this method, the fidelity problem caused by the mask itself can be clearly identified, and a best OPC model or a best mask can be selected for final manufacturing need. In short, the non-OPC related errors may include errors resulting from photolithography processes, rather than from the OPC mask itself or methods of making the mask. Claim 8 has been amended to more clearly point this out. Accordingly, one of ordinary skill in the art would be enabled to make and use the method of Claim 8 in view of the phrase "non-OPC related errors related to photolithographic processes" and the rejection of claim 8 under 35 U.S.C. §112, first paragraph, should be withdrawn.

Claim Rejections under 35 U.S.C. §112, Second Paragraph

The Action also rejects Claims 1, 6 and 8 under 35 U.S.C. §112, second paragraph, and contends that Claims 1, 6 and 8 fail to comply with the definiteness requirement. Specifically, the Action states that the feature of "predetermined photolithograph processing condition" recited in Claims 1 and 6 is not clarified; and that the feature of "non-OPC related errors" is not clarified. Applicants submit that Claims 1, 6 and 8 satisfy the enablement requirement of 35 U.S.C. §112, second paragraph in view of the amendment to claim 8 and the following arguments.

M.P.E.P. §2173 Claims Must Particularly Point Out and Distinctly Claim the Invention

> The primary purpose of this requirement of definiteness of claim language is to ensure that the scope of the claims is clear so the public is informed of the boundaries of what constitutes infringement of the patent. A secondary purpose is to provide a clear measure of what applicants regard as the invention so that it can be determined whether the claimed invention meets all the criteria for patentability and whether the specification meets the criteria of 35 U.S.C. 112, first paragraph with respect to the claimed invention.

M.P.E.P. §2173.02 further states that the essential inquiry pertaining to this requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. Definiteness of claim language must be analyzed, not in a vacuum, but in light of: (A)The content of the particular application disclosure; (B)The teachings

DM2\867797.3

PAGE 13/21 * RCVD AT 11/30/2006 6:42:22 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-3/17 * DNIS:2738300 * CSID:6197442201 * DURATION (mm-ss):06-16

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

of the prior art; and (C)The claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made.

As set forth above, one of ordinary skill in the art would understand that the phrase "predetermined photolithography processing condition" recited in Claims 1 and 6 refers to conditions for forming a photoresist pattern, such as wavelength, the partial coherence of the exposure light, illumination aperture and the imaging numerical aperture (NA) of the optical exposure system, etc.

The Action also rejects Claims 1 and 6, contending that there is insufficient antecedent basis for the phrase "OPCed mask design" and that this term should be clarified. Claims 1 and 6 have been amended to recite "... thereby generating an OPCed mask design. ..." (Emphasis added). Withdrawal of the rejection of insufficient antecedent for the phrase "OPCed mask design" is respectfully requested.

In addition, based on Claim 1, the OPCed mask design is generated by applying an OPC model to a predetermined mask design. In other words, the generated OPCed mask design includes a predetermined mask design which is modified by the OPC model. Accordingly, one of ordinary skill in the art would understand the scope of Claim 1 and the phrase "OPCed mask design" is sufficiently definite.

Claim 6 has been amended to recite "... a second processing tool for applying the first OPC model to a mask design represented by the database mask file, thereby generating an OPCed mask design. ..." (Emphasis added). As discussed above with respect to Claim 1, the phrase "OPCed masked design" is sufficiently definite with the amendment of Claim 6 and the rejection of Claim 6 under § 112, second paragraph, should be withdrawn.

Further, Applicants respectfully submit that the amended phrase "non-OPC related errors related to photolithographic processes" recited in amended Claim 8 is not directed to errors relating to an OPC mask, OPC model or a method of forming an OPC mask, and sufficiently definite to one of ordinary skill in the art.

DM2\867797.3

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

Based on the foregoing, the rejection of Claims 1, 6 and 8 under §112, second paragraph

should therefore be withdrawn.

Claim rejections under 35 U.S.C. §102(b)

The Action rejects Claims 1 – 11 under 35 U.S.C. §102(b), contending that the claims are

anticipated by U.S. Patent No. 6,272,236 to Pierrat et al. ("Pierrat").

Claim 1 recites

> generating a mask picture from a first mask, the first mask being made from a
> predetermined mask design with a first OPC model applied thereto;
> converting the mask picture into a simulation required mask file;
> conducting a first simulation under a first set of predetermined
> photolithography processing conditions using the simulation required mask file
> to generate one or more files of a first set representing a first wafer photo resist
> profile thereof;
> applying the first OPC model to the predetermined mask design in a database
> mask file format, thereby generating an OPCed mask design;
> conducting a second simulation under the first set of predetermined
> photolithography processing conditions using the OPCed mask design to
> generate one or more files of a second set representing a second wafer photo
> resist profile thereof; and
> comparing the first and second sets of files. (Emphasis added).

Applicants submit that Pierrat fails to teach or suggest the features as set forth above.

Pierrat is directed to a technique for inspecting photomasks. In Pierrat, simulated image

185 of an original pattern data is compared to simulated image 180 generated from a pattern

captured from a photomask manufactured from the original pattern data in order to check mask

defects. Specifically, Pierrat in FIG. 5 shows that mask 330 is manufactured from original data

310, i.e., data associated with original designed circuits. Nothing in the description or drawings

of Pierrat shows making mask 330 from a predetermined mask design with an OPC model. As

known in the art, an OPC (Optical Proximity Correction) model is applied to pattern data of a

mask and used to compensate for image errors due to diffraction or process effects. For example,

in some OPC models, an OPC distortion may be added to corners of a layout pattern of a mask

so as to compensate for diffraction effects. The Examiner referred to the resist behavior shown

Page 12 of 17

DM2\867797.3

PAGE 15/21 * RCVD AT 11/30/2006 6:42:22 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-3/17 * DNIS:2738300 * CSID:6197442201 * DURATION (mm-ss):06-16

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

in FIG. 5 as an OPC model. Based on the above description of OPC, Applicants submit that an OPC model quite distinguished from a model of resist behavior.

Further, Claim 1 recites using the simulation required mask file to generate one or more files of a first set representing <u>a first wafer photo resist profile thereof</u> and using the OPCed mask design to generate one or more files of a second set representing <u>a second wafer photo resist profile thereof</u>. In short, the simulation required mask file and OPCed mask design are used to simulate <u>photo resist profiles</u>. Unlike Claim 1, Pierrat merely simulates **a pattern on the mask.** Applicants thus submit that Pierrat fails to teach or suggest the claimed features of Claim 1.

Applicants submit that Pierrat directs one of ordinary skill in the art to make a mask based on **original pattern data 310.** Otherwise simulated image 180 cannot be provided to compare with simulated image 185 generated from the original pattern data. It is submitted that one of ordinary skill in the art would not have motivated to modify Pierrat to achieve the claimed features recited in Claim 1. Accordingly, Claim 1 is not anticipated by Pierrat and the rejection of claim 1 under 35 U.S.C. 102 (b) as being anticipated by Pierrat should therefore be withdrawn. Claim 1 is allowable.

Claims 2-5 depend from Claim 1 and the rejection of Claims 2-5 under 35 U.S.C. 102 (b) should also be withdrawn. Claims 2-5 are allowable for at least the reasons set forth above in connection with Claim 1.

Claim 6 recites " . . . a second processing tool for applying the <u>first OPC model</u> to a mask design represented by the database mask file, thereby generating an OPCed mask design; a simulation tool for conducting a first simulation under a first set of predetermined lithography processing conditions using the converted mask file to generate one or more files of a first set representing a wafer photo resist profile thereof and conducting a second simulation under the first set of predetermined lithography processing conditions using the OPCed mask design to generate <u>one or more files of a second set representing a wafer photo resist profile thereof;</u> . . . ." (Emphasis added).

Claim 6 is therefore also not anticipated by Pierrat for reasons set forth in the above argument with respect to Claim 1 and the rejection of Claim 6 under 35 U.S.C. 102 (b) as being

Page 13 of 17

DM2\867797.3

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

anticipated by Pierrat, should also be withdrawn. Claim 6 is therefore allowable over the art of record.

Claims 7-11 depend from Claim 6 and are also distinguished from Pierrat and allowable for at least the reasons set forth above in connection with Claim 6.

The Action also rejected Claims 1 and 6 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,078,738 to Garza et al. ("Garza").

Independent Claim 1 recites " . . . applying the first OPC model to the predetermined mask design in a database mask file format; conducting a second simulation under the first set of predetermined photolithography processing conditions using the OPCed mask design to generate one or more files of a second set representing a second wafer photo resist profile thereof; . . . ." (Emphasis added). In short, the files of the second set are generated by using the OPCed mask design which is created based on the first OPC model. Applicants submit that Garza fails to teach the claimed features.

Garza is directed to a method of simulating a masking process in which a process simulator is used to produce an image. In step 218 of FIG. 7, Garza compares the first database generated by step 212 and the second database generated by step 216 in order produce an error database. The first database is created based on an aerial image representing an simulator's estimation of a pattern that would be produced by the masking process using the pattern mask. The second database is created by generating a digital presentation of a PR (photoresist) pattern which is produced by the masking process in step 214. Neither the first database nor the second database of Garza is generated from simulating photolithography processing conditions using an OPCed mask design which is generated based on an OPC model.

Further, Claim 1 recites using the simulation required mask file to generate one or more files of a first set representing a first wafer photo resist profile thereof and using the OPCed mask design to generate one or more files of a second set representing a second wafer photo resist profile thereof. In short, the simulation required mask file and OPCed mask design are used to simulate photo resist profiles. Unlike Claim 1, Garza merely simulates a pattern on the mask. Applicants thus submit that Garza fails to teach or suggest the claimed features of Claim 1.

Page 14 of 17

DM2\867797.3

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

The Action also refers to "estimate of mask pattern" as an OPC model. Applicants respectfully disagree. An estimate of a mask pattern merely estimates or apprises the mask pattern without modifying the mask pattern. Unlike an estimate of a mask pattern, an OPC model is applied to pattern data of a mask and used to <u>compensate</u> for image errors due to diffraction or process effects. Quite simply, the use of an OPC model is distinguished from an estimate of mask patterns. Accordingly, it is submitted that Claim 1 is not anticipated by Garza and therefore, the rejection of Claim 1 under 35 U.S.C. §102 as being anticipated by Garza should be withdrawn for at least the reasons set forth above.

Claims 2 – 5 depend from Claim 1 and are also distinguished from Garza for at least the reasons set forth above in connection with Claim 1.

Claim 6 is a system for mask fidelity inspection. Claim 6 recites

"an image capturing tool for generating a mask picture from a first mask
with a <u>first OPC model</u> applied to a mask design thereon; . . . a second
processing tool for <u>applying the first OPC model</u> to a mask design
represented by the database mask file; a simulation tool for conducting a
first simulation under a first set of predetermined lithography processing
conditions using the converted mask file to generate one or more files of a
first set representing a wafer photo resist profile thereof and conducting a
second simulation under the first set of predetermined lithography
processing conditions <u>using the OPCed mask design</u> to generate one or
more files of a second set representing a wafer photo resist profile thereof;
. . . ." (Emphasis added).

For reasons set forth above in connection with Claim 1, Pierrat and Garza fail to teach or suggest an image capturing tool for generating a mask picture from a first mask with a <u>first OPC model</u> applied to a mask design thereon recited in Claim 6. Therefore, Claim 6 is not anticipated by the Garza and the rejection of Claim 6 under 35 U.S.C. 102 (b) as being anticipated by Garza should therefore be withdrawn for at least the reasons set forth above in connection with Claim 1.

Claims 7 – 11 depend from Claim 6 and are also distinguished from Garza and the rejection of Claims 7-11 under 35 U.S.C. 102(b) as being anticipated by Garza should therefore be withdrawn for at least the reasons set forth above in connection with Claim 6.

Page 15 of 17

DM2\867797.3

PAGE 18/21 * RCVD AT 11/30/2006 6:42:22 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-3/17 * DNIS:2738300 * CSID:6197442201 * DURATION (mm-ss):06-16

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

Claim rejections under 35 U.S.C. §103(a)

The Action rejected Claims 2 and 7 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,078,738 to Garza et al. ("Garza") in view of U.S. Patent Publication No. 2004/0172611 to Pang ("Pang").

As conceded by the Action, Garza fails to teach setting one or more thresholds of the wafer photo resist profile for rejecting the first OPC model used.

Claim 2 depends from Claim 1. As argued above in connection with Claim 1, Garza fails to teach or suggest the claimed features recited in Claim 1. Pang is directed to a simulation tool which generates a simulated wafer image having the accuracy of a resist model with the speed of an optical model by using a threshold look-up table (LUT). Pang, however, fails to cure the deficiency of Garza. Accordingly, Applicants submits that Claim 2 is not obvious by Garza in view of Pang. The rejection of Claim 2 under 35 U.S.C. §103, should therefore be withdrawn.

Claim 7 depends from Claim 6, reciting that the comparison tool further includes means for quantifying mask fidelity errors for rejecting the first OPC model used. Claim 6 is distinguished from Garza for reasons set forth above. Pang, however, fails to cure the deficiency of Garza. Claim 7 is not obvious over the art of record. The rejection of Claim 7 under 35 U.S.C. §103, should therefore be withdrawn.

In view of the foregoing, reconsideration and withdrawal of the rejections of these claims are respectfully requested.
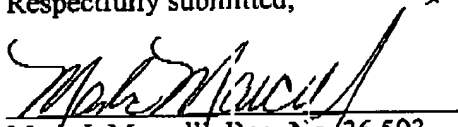
DM2\867797.3

Appl. No. 10/665,451
Reply to Non-Final Office Action of August 15, 2006

Conclusion

In view of the foregoing amendments and remarks, Applicants submit that this application is in condition for allowance. Early notification to that effect is respectfully requested.

The Assistant Commissioner for Patents is hereby authorized to charge any additional fees or credit any excess payment that may be associated with this communication to deposit account **04-1679**.

Respectfully submitted,

Dated: November 30, 2006

Mark J. Marcelli, Reg. No. 36,593
Attorney for Applicant

DUANE MORRIS LLP
101 West Broadway, Suite 900
San Diego, CA 92101
Telephone: (619) 744-2200
Facsimile: (619) 744-2201

Attachment: Abstract

Page 17 of 17

DM2\867797.3

PAGE 20/21 * RCVD AT 11/30/2006 6:42:22 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-3/17 * DNIS:2738300 * CSID:6197442201 * DURATION (mm-ss):06-16